



Market Priorities for Energy System Integration

ESIG October, 2023

San Diego, CA

Bend, OR

Dornbirn, Austria



Energy System Integration

It's Big !!

2x to 3x 2022 Electricity
Demand by 2050

It will happen suddenly

Pace driven by end users more
than utilities

It will make it easier
and harder to run
power grids



It doesn't fit into the
current system and
market, but it's
coming anyway.....



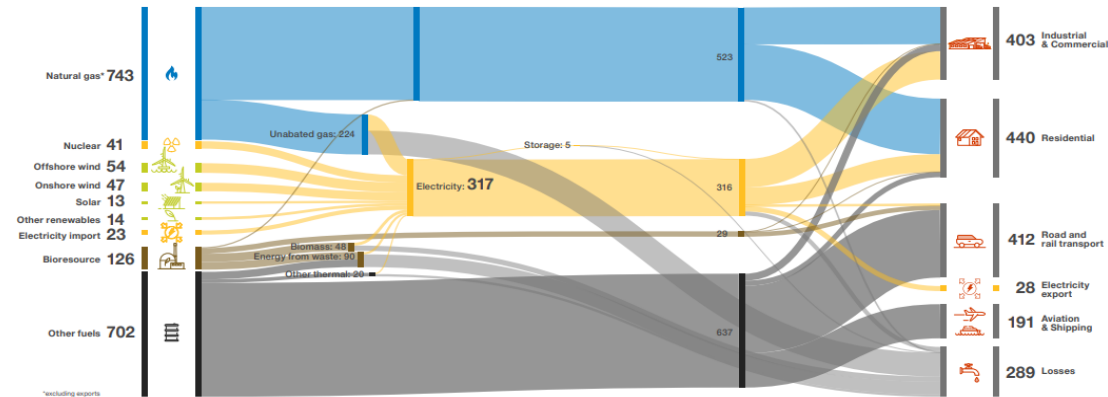
What should we do
differently?

2050 Electricity usage will be 2 or 3 x 2022 Volumes

Energy supply and demand

2022 (1763 TWh)

- Fossil fuels make up 82% of total energy supply in 2022
- Petroleum supplies 93% of road transport demand and 100% of aviation and shipping demand
- Interactions between different fuels are low, demonstrating limited whole system thinking

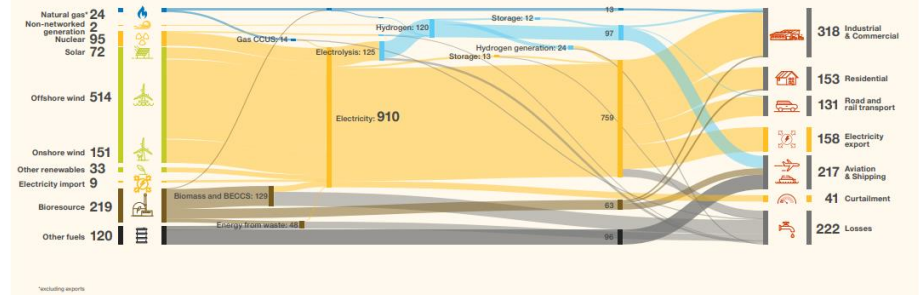


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Energy supply and demand in 2050

Consumer Transformation (1239 TWh)

- Home heating, transport and industry largely electrified
- High levels of energy efficiency combined with large-scale electrification lead to lowest consumer energy demands across the scenarios excluding aviation
- High levels of renewable generation with low hydrogen production leads to the highest levels of electricity curtailment and export of any of the scenarios
- Two thirds of hydrogen produced is used in aviation, with another 20% used for electricity generation, to help meet security of supply



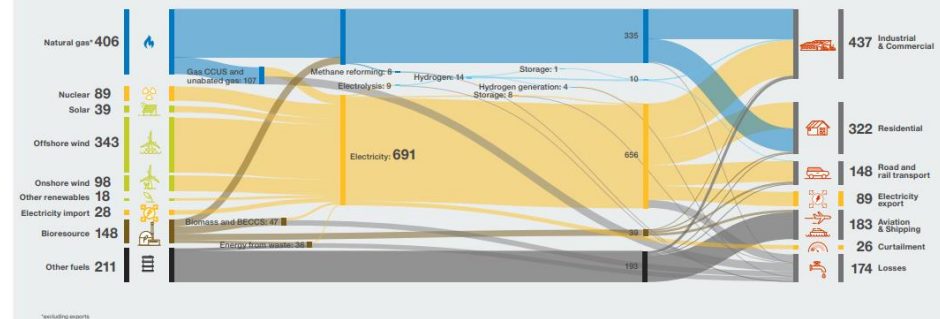
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Energy supply and demand in 2050

Falling Short (1380 TWh)

- Continued high usage of natural gas, particularly for domestic heating and industry
- Small private vehicles fully electrified (including some plug-in hybrids) whilst HGVs rely on fossil fuels
- Low use of hydrogen as production isn't decarbonised
- Highest total end-user energy demand due to minimal increase in energy efficiency measures and reliance on inefficient fossil fuels



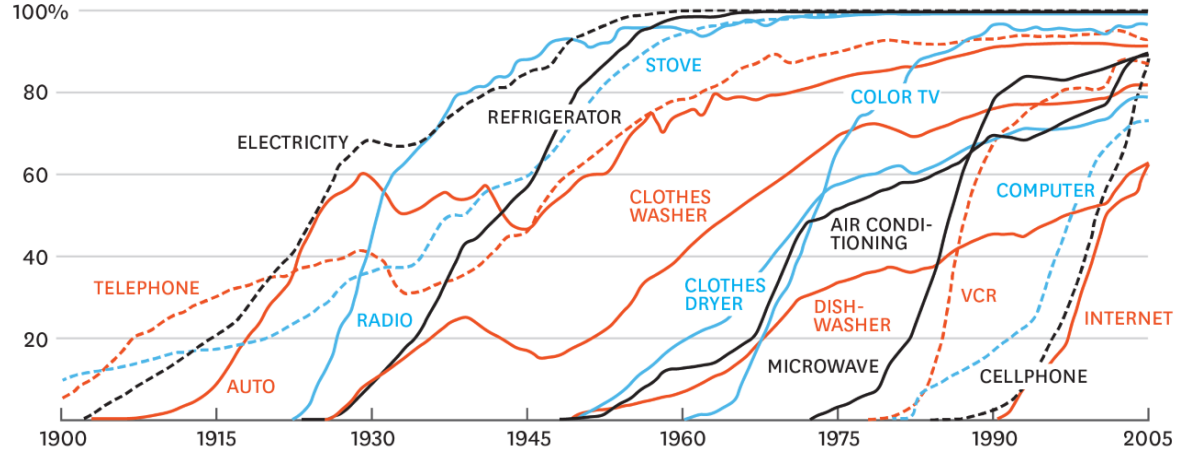
*excluding exports

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Natural Pace will be driven by user adoption rather than utilities

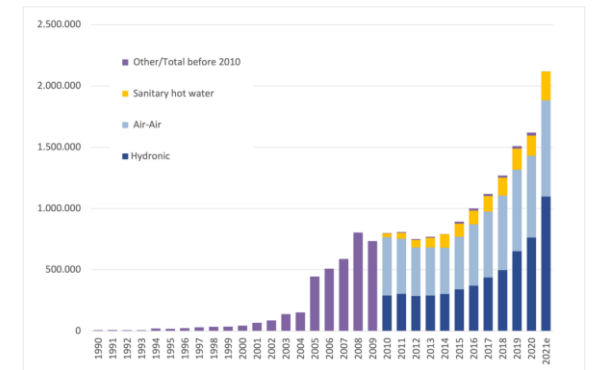
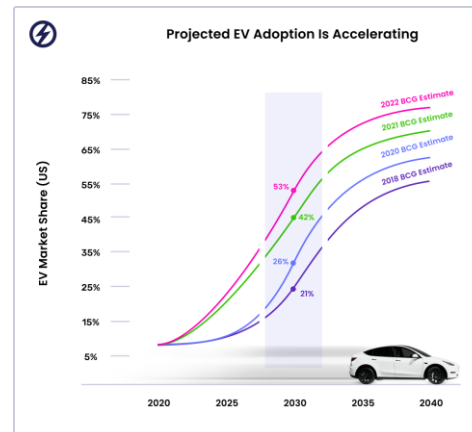
CONSUMPTION SPREADS FASTER TODAY

PERCENT OF U.S. HOUSEHOLDS



SOURCE NICHOLAS FELTON, THE NEW YORK TIMES

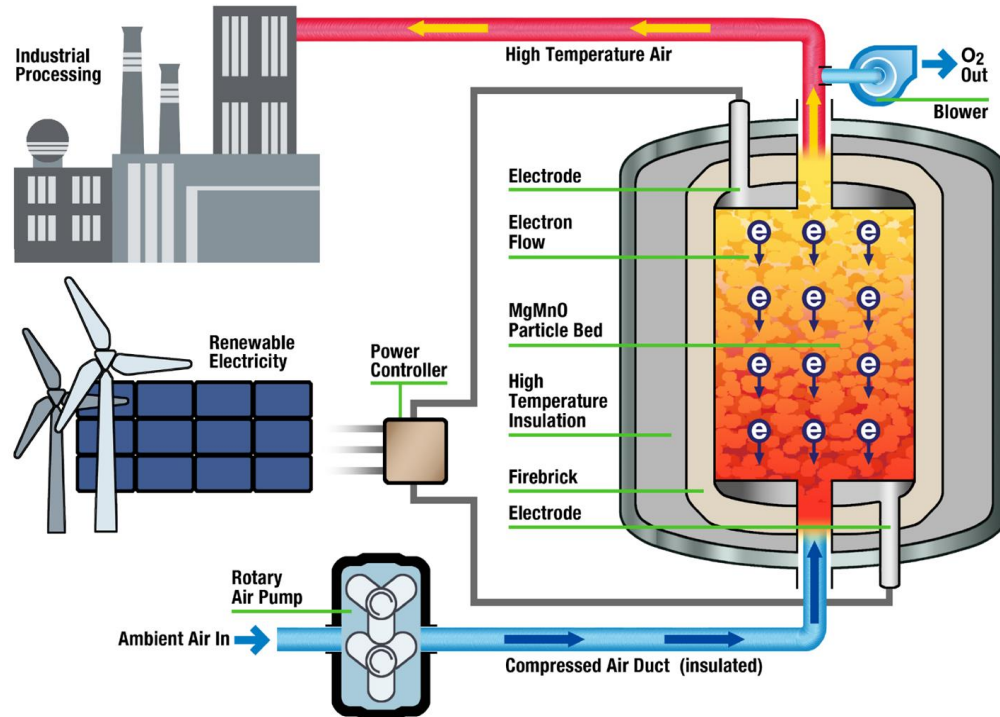
HBR.ORG





Technology is coming quickly to electrify more sectors

electricity $\Rightarrow$ heat $\Rightarrow$ store $\Rightarrow$ heat
~ 95% roundtrip efficiency



Can be charged by Electricity or
Natural Gas

Energy Dense, Low Capex
Thermochemical Storage

Delivers on demand heat up to
1500°C heat

2030 Irish RES Surplus & Industrial Heat Demand

- A significant surplus of resource of renewable energy resources expected in 2030

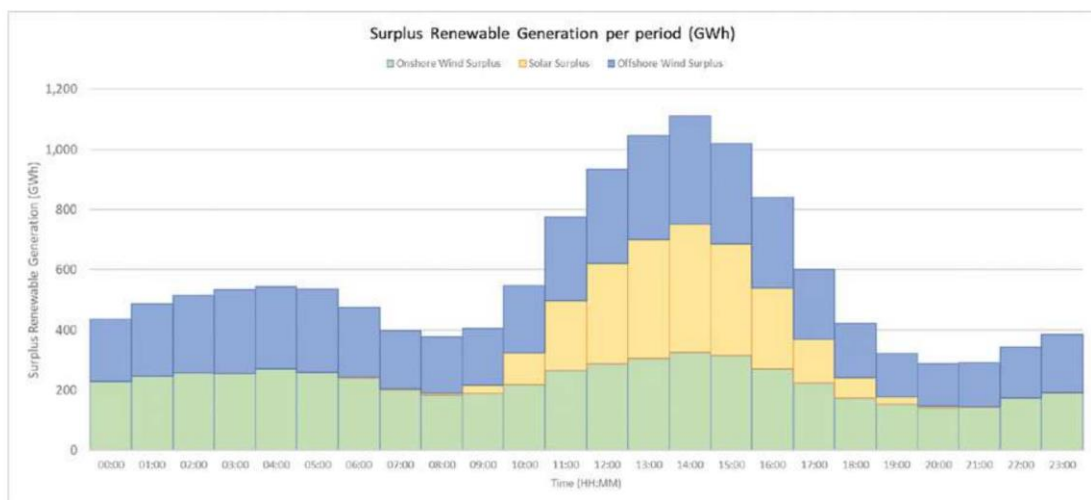
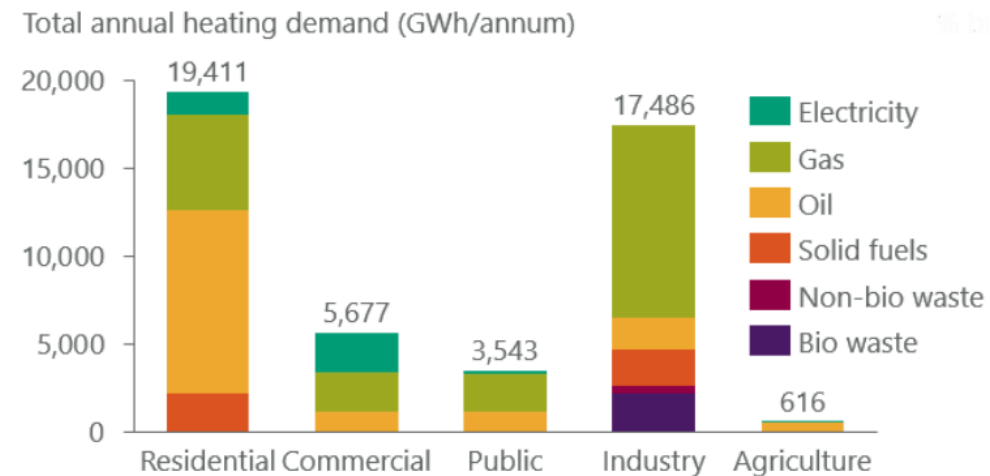


Figure 18: Summation of surplus renewable generation for each hour in 2030

Source: EirGrid, 2023. https://www.eirgridgroup.com/site-files/library/EirGrid/Shaping-Our-Electricity-Future-Roadmap_Version-1.1_07.23.pdf

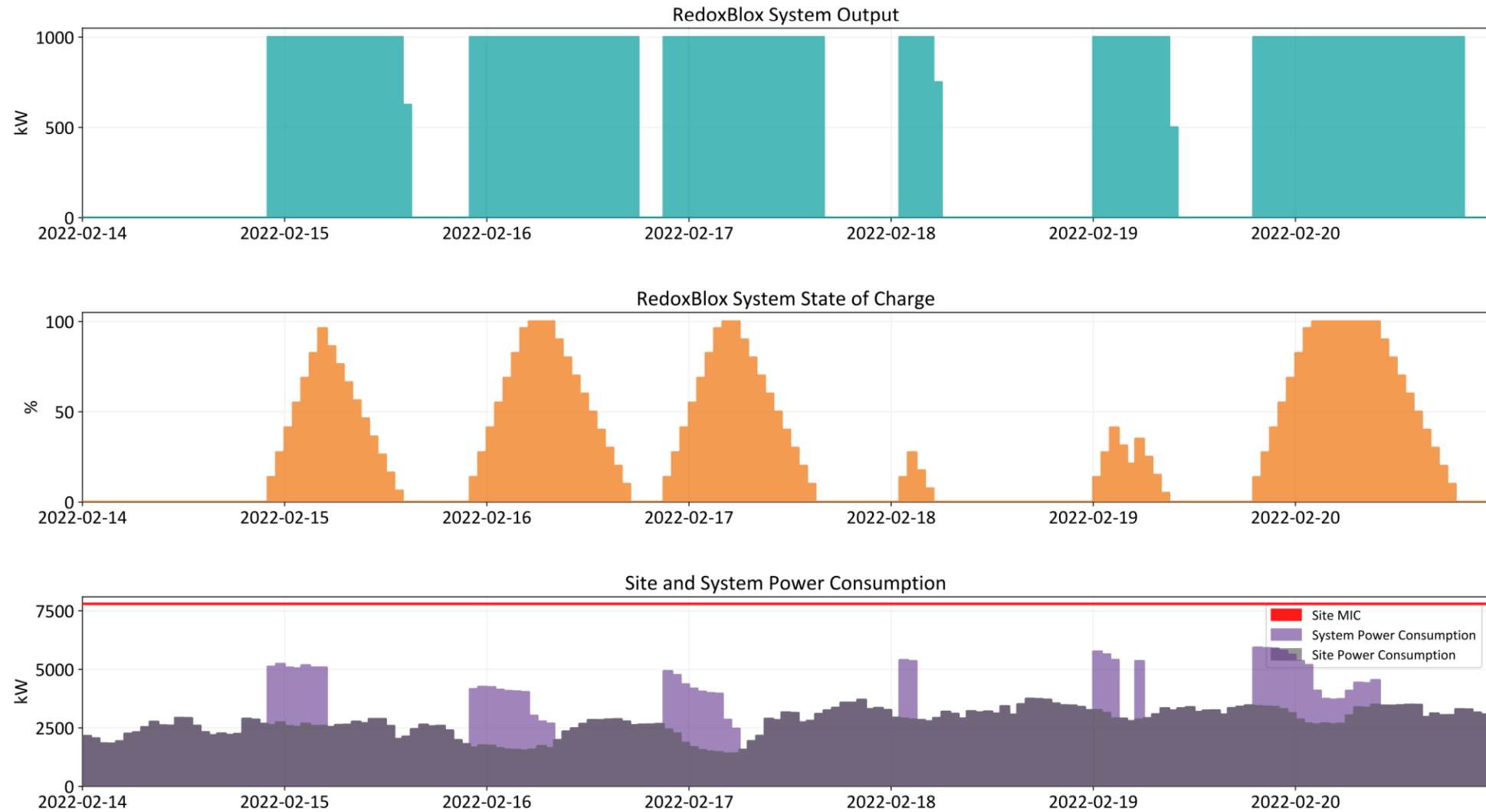
- Comparable to the demand for industrial heat

Figure 5: Total annual heating demand (GWh/annum), by sector

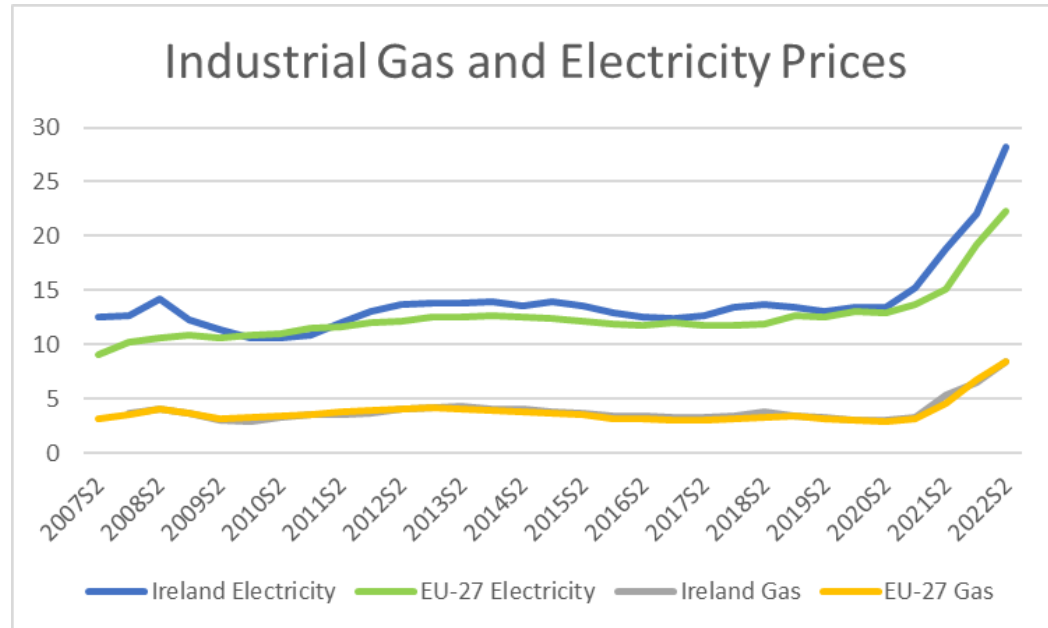


Source: SEAI, 2022. <https://www.seai.ie/publications/Heating-and-Cooling-in-Ireland-Today.pdf>

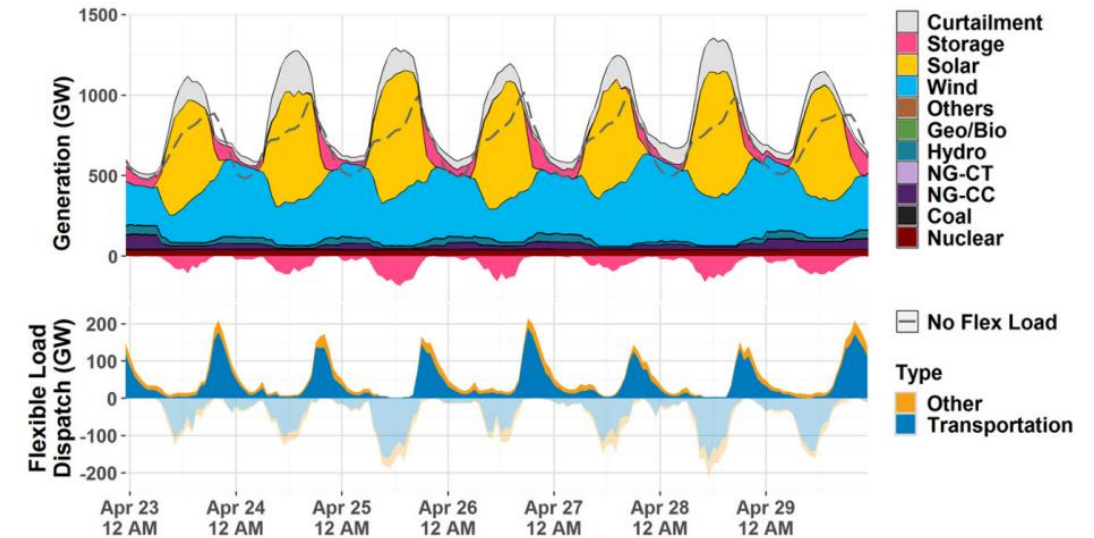
Sample Week Profile – 10% heat on site electrified



Markets and Services



Industrial Gas is much cheaper than Industrial Electricity

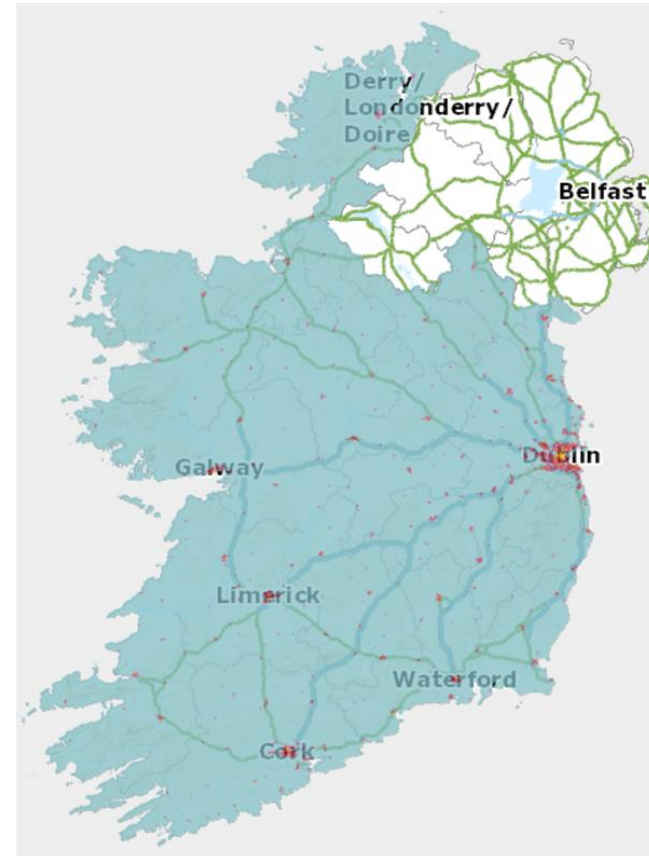


Electrification of industrial heat can provide grid services

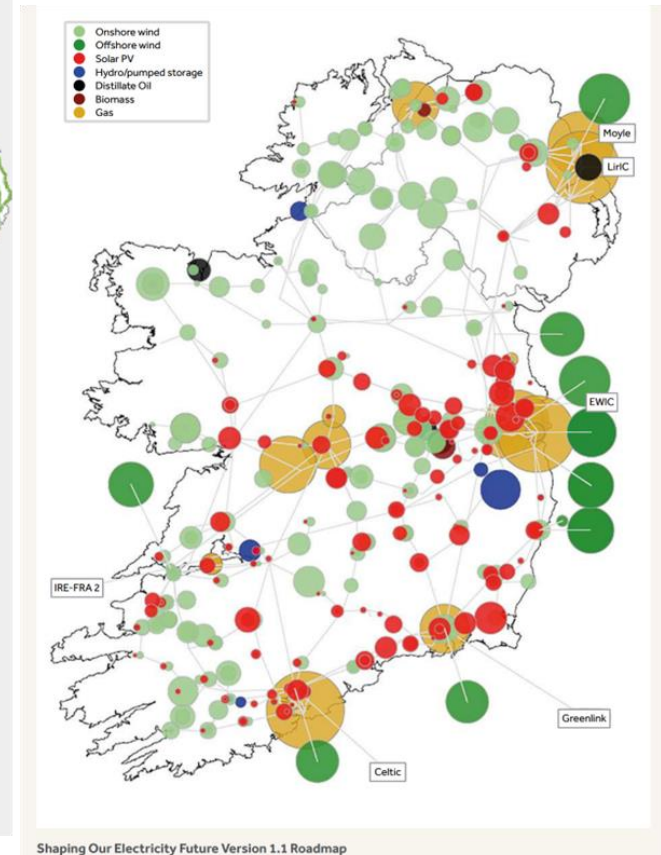
Grids and Tariffs

Reduce new network need by proactive co-ordination of industrial electrification, RES connections & local considerations

Network tariffs, other charges, wholesale markets and decarbonisation incentives speak different languages



Source: EirGrid, 2023. https://www.eirgridgroup.com/site-files/library/EirGrid/Shaping-Our-Electricity-Future-Roadmap_Version-1.1_07.23.pdf

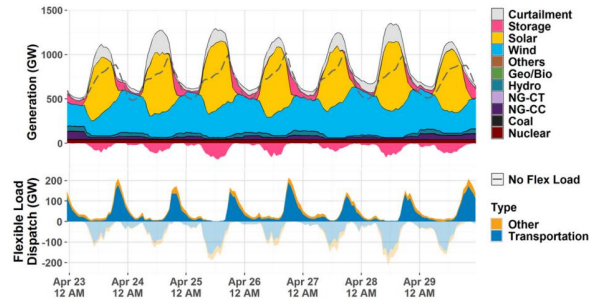


Source: SEAI, 2021. <https://gis.seai.ie/heatdemand/>

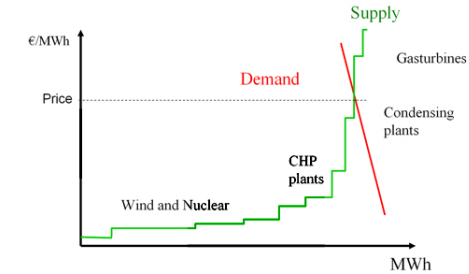
Priorities



Meaningful Whole System Planning



Apply lessons from RES support to LCT incentives



Develop a Net Zero ready market with sensible grid and services signals



Plans must be realistic, Net Zero compatible & acceptable to society